Federate Testing Process

Integrated Training Program

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Federate Testing Development

Federate testing has been part of HLA since the baseline:

- **Compliance Checklist: the Definition of Compliance**
  - **Initially developed as part of HLA baseline development process; maintained along with HLA Specification Version 1.1**
- **Test Procedures: the technical testing steps used to address checklist items**
  - **Developed as part of HLA baseline development; these have also been updated to reflect specification evolution**
- **Test Process: a series of activities with supporting tools a federate uses to assess compliance with HLA**
  - **Draft process has been developed; testing and evolution of the process and tools is underway**
  - **Plan is for testing to be available during FY98**

HLA Compliance Checklist

- Procedure-oriented description of requirements for HLA compliance
  - Integrates elements from definition
    - Rules, Interface specification, OMT specifications
- Three components
  - Federate Checklist
  - Federation Checklist
  - RTI Checklist
- Initial emphasis is on federate and federation checklists
  - RTI checklist is critical to RTI certification

Federate Checklist

Compliance Item 1: The federate has an HLA SOM in OMT format (OMT specification)

	OMT Ref
Object Class Structures	3.1
Object Interactions	3.2
Attributes and Parameters	3.3
Lexicon	3.4

Federate Checklist

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Attributes and Parameters	3.3
Lexicon	3.4

Federate Checklist

Compliance Item 2: The federate is able to publish/ reflect any attributes of objects in their SOM and exercise SOM object interactions externally

	IF Ref	OMT Ref
Publish Object/Interaction Class	3.1, 3.2	3.1,3.2,3.3
Subscribe Object Class Attributes	3.3	3.1,3.3
Subscribe Interaction Class	3.4	3.2
Control Updates†, Interactions†	3.5, 3.6	
Update/Reflect† Attribute Values	4.3, 4.5	3.2,3.3
Send/Receive† Interaction	4.6, 4.7	3.2
Request/Provide† Attrib. Val. Update	4.14,4.15	
Retract/Reflect Retract†	4.16,4.17	

Federate Checklist

Compliance Item 3: Federates must be able to own or reflect attributes and to transfer/accept ownership of attributes dynamically during a federation execution, as specified in their SOM

	IF Ref	OMT Ref
Request Attrib. Ownership Divest.	5.1	3.3
Request Attrib. Ownership Assump.†	5.2	3.3
Attrib. Ownership Divest. Notification†	5.3	3.3
Attrib. Ownership Acquis. Notification†	5.4	3.3
Request Attrib. Ownership Acquis.	5.5	3.3
Request Attrib. Ownership Release†	5.6	3.3
Query/Inform† Attrib. Ownership	5.7,5.8	
Is Attribute Owned by Federate	5.9	

Federate Checklist

Compliance Item 4: Federates must be able to vary the conditions under which they provide updates of public attributes of objects according to their SOM

	IF Ref	OMT Ref
Update Attribute Values	4.3	3.2,3.3
Reflect Attribute Values†	4.5	3.3

Federate Checklist

Compliance Item 5: Federates must be able to manage local time in a way which will allow them to coordinate data exchange with other members of a federation in accordance with at least one of the available HLA time management services

	IF Ref	OMT Ref
Request Federation Time	6.1	
Request LBTS, Federate Time	6.2, 6.3	
Request Min Next Event Time	6.4	
Set/Request Lookahead	6.5, 6.6	
Time Advance Request/Grant†	6.7, 6.10	
Next Event Request	6.8	
Flush Queue Request	6.9	

Federate Checklist

Compliance Item 6: During a federation execution, federates must interact with the runtime infrastructure (RTI) in accordance with the HLA interface specification

	IF Ref	OMT Ref
Create / Destroy / Join / Resign	2.1-2.4	
Pause / Resume / Save / Restore	2.5-2.17	
Request ID	4.1	
Register / Discover† Object	4.2, 4.4	3.1
Delete / Remove† Object	4.8, 4.9	
Change Attrib Trans / Order Type	4.10, 4.11	
Change Interact Trans / Order Type	4.12, 4.13	

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Testing Philosophy

- Federates are tested to the HLA Specifications (IF, OMT, Rules)
- Test process is straightforward:
  - Federate Under Test (FUT) submits a description of its capabilities via a SOM and Conformance Statement (CS) to the Certification Agent
  - Federate demonstrates it can use the specifications correctly through a set of tests
  - Certification agent verifies the federate conforms to the specifications by analyzing test results
- Test process is supported by automated tools to reduce time and cost associated with testing

Test Terminology

HLA Compliance = HLA Compliance Checklist

- **Compliance Checklist is Evaluated by Conformance Tests**
  - **OMT Conformance Test**
    - **Completeness, Consistency**
  - **IFSpec Conformance Test**
    - **Nominal, Representative SOM (RepSOM) data**
  - **Conformance Cross-Check Test**
    - **Ensure that the SOM and Conformance Statement (CS) are consistent**

Traceability

Compliance Checklist Item	Applicable Test(s)
1.	OMT Conformance Test
2.	Conformance Cross-Check, IF Test (Nominal and RepSOM)
3.	Conformance Cross-Check, IF Test (Nominal and RepSOM)
4.	Conformance Cross-Check, IF Test (RepSOM)
5.	IF Test (Nominal)
6.	IF Test (Nominal)

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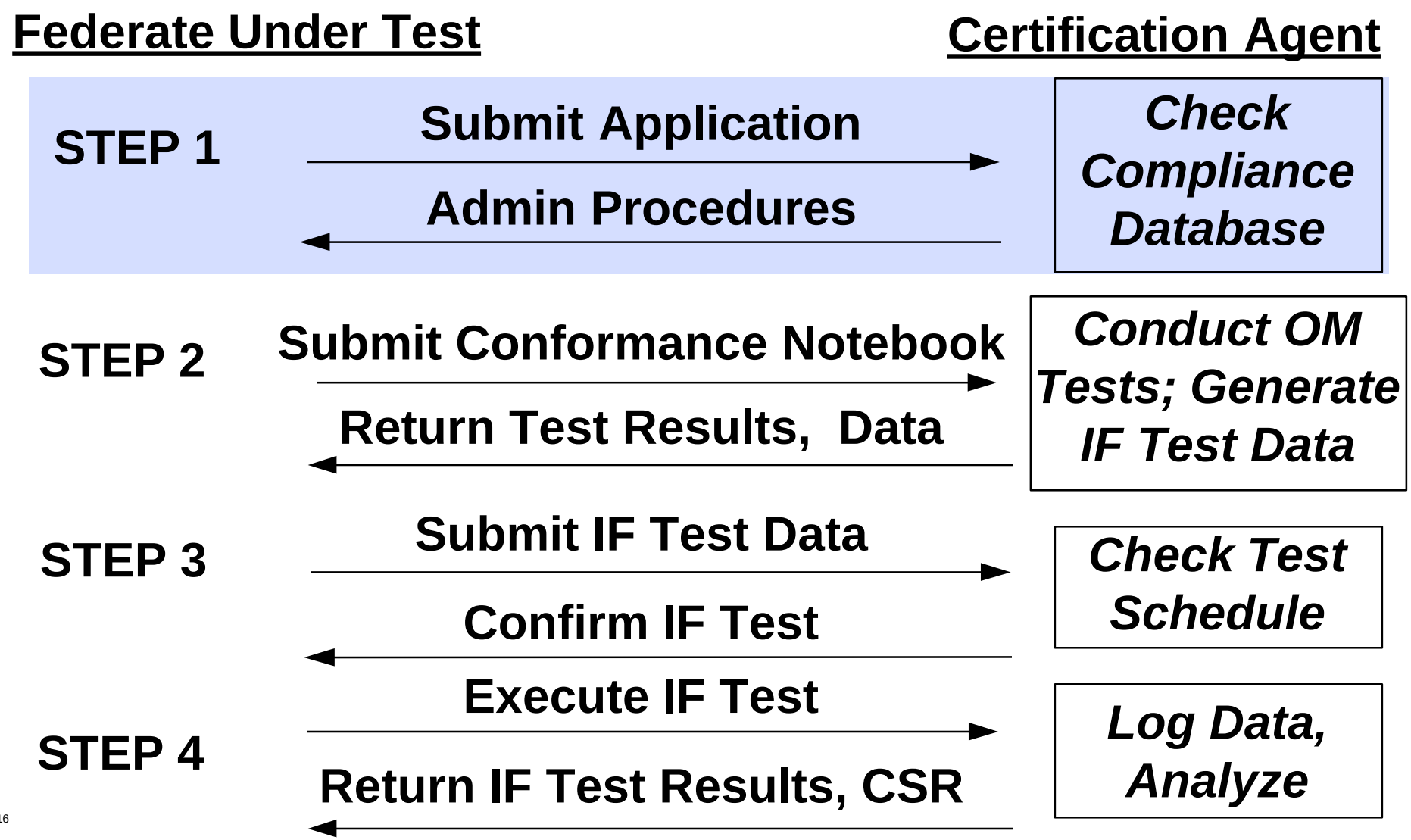
The Test Process



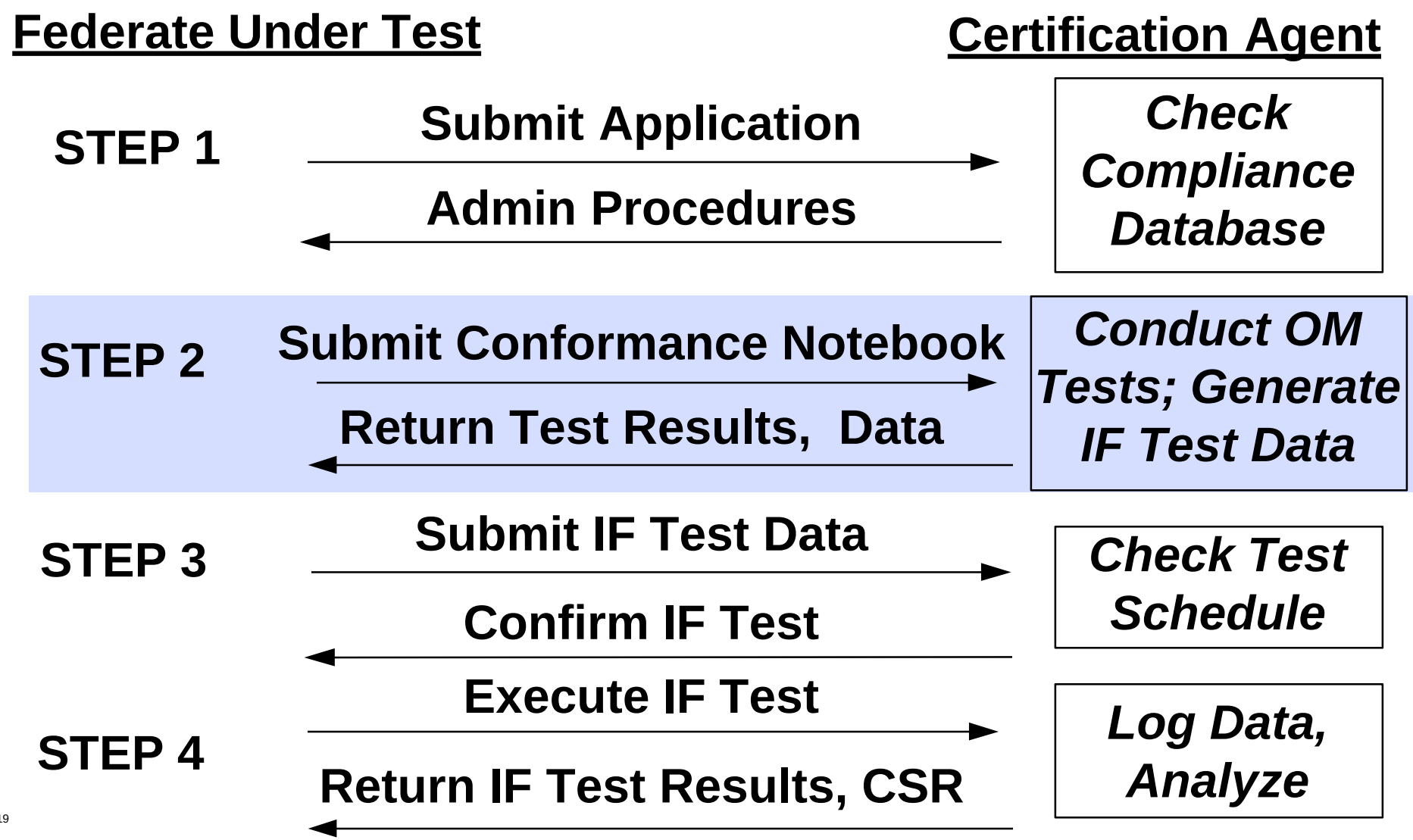
Step 1: Application

- The test process is initiated when a simulation owner submits a request for information (test application)
- In response to this request, the Certification Agent will provide the simulation owner with materials describing:
  - The Federate Test Process ("Conformance Guide")
  - Test Administration Procedures

Conformance Guide

- Introduction
  - Conformance Process
  - HLA Compliance Checklist
- Test Process
  - Object Model Template Tests
    - Parseable, Complete, Consistent
  - Conformance Cross-Check
  - Interface Specification Tests
    - Nominal, RepSOM, Test Sequence
- Test Instructions
  - Conformance Notebook
  - Test Set-Up
- Certification Summary Report

The Test Process



Step 2: OM Tests

- **The next step of the test process starts when the Federate Under Test (FUT) submits the Conformance Notebook to the Certification Agent (CA):**
- **Conformance Notebook = SOM +CS+ Scenario Data**
- **The first test the CA conducts is to test the SOM for conformance to the OMT (SOM Conformance Test)**
- **Once the FUT successfully completes the SOM test, the CA tests consistency between the CS and SOM (Conformance Cross-Check Test)**
- **Upon successful completion of the cross-check, the CA will return the test results, generate the FUT's Interface Test Sequence, and schedule the FUTs IF test**

Conformance Statement

Service	IF Ref	OMT Ref	Cklist	M/O	?
Create Federation Execution	2.1	None	6	M	Y
Destroy Federation Execution	2.2	None	6	M	Y
Join Federation Execution	2.3	None	6	M	Y
ResignFederation Execution	2.4	None	6	M	Y
Request Pause	2.5	None	6	O	Y/N
Initiate Pause†	2.6	None	6	O	Y/N
Pause Achieved	2.7	None	6	O	Y/N
Request Resume	2.8	None	6	O	Y/N
Initiate Resume†	2.9	None	6	O	Y/N
Resume Achieved	2.10	None	6	O	Y/N

. . . and so on . . .

Scenario Data

- Instead of creating a new database/ scenario to support testing, the FUT has the option of submitting existing scenarios to the Certification Agent for consideration in generating the RepSOM
- Scenario Format is straightforward
  - OMT DIF file with objects, attributes, interactions, and parameters

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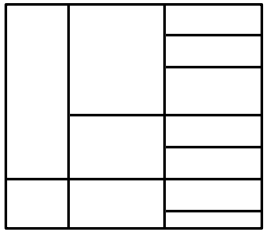
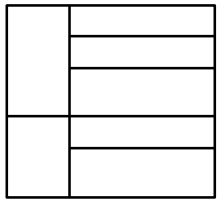
Agent Conducts SOM and X-Check Tests

Conformance Notebook

Simulation Object Model



Available Scenario Data



Conformance Statement

SOM Test

Parseable
Complete
Consistent

Conformance Cross-Check

OMT Table	In SOM? (Yes/No)	IF Service Name	In CS? (Yes/No)
Object Class			
(P)		Publish Object Class	
		Register Object	
(S)		Subscribe Object Class Attributes	
		Discover Object	
Object Interaction			
(I)		Publish Interaction Class	
		Send Interaction	
(S)		Subscribe Interaction Class	
		Receive Interaction	
(R)		Receive Interaction	
		Update Attribute Values	
		Publish Object Class	

SOM Conformance Test

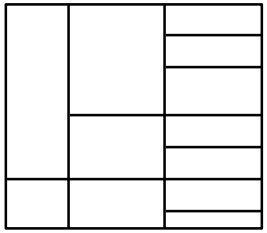
- SOM Conformance is evaluated by a set of completeness and consistency rules, for example:
  - The class name is checked to make sure it does not conflict with another class
  - The attribute name is checked to make sure it does not conflict with another attribute in its owning class
  - Updateable and Reflectable options are checked.
  - Initiate, Sense and React options are checked.

*DMSO provided Object Model Development Tools enforce these rules

Agent Conducts SOM and X-Check Tests

Conformance Notebook

Simulation Object Model



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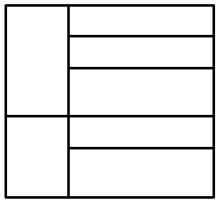

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		Receive Interaction	
(R)		Receive Interaction	
		Update Attribute Values	
		Publish Object Class	

Conformance Cross-Check

OM Table		In SOM?	IF Service	In CS?	Match?
Class (P)			Publish Object		
			Register Object		
	(S)	X	Subscribe Attrib.	X	Yes
			Discover Object	X	Yes
Interaction	(I)	X	Publish Interaction	X	Yes
			Send Interaction	X	Yes
	(S)	X	Subscribe Interaction	X	Yes
			Receive Interaction	X	Yes
	(R)	X	Receive Interaction	X	Yes
			Update Attrib. Values		No
			Publish Object		No

. . . and similarly for Attributes and Parameters (U, R, A, T)

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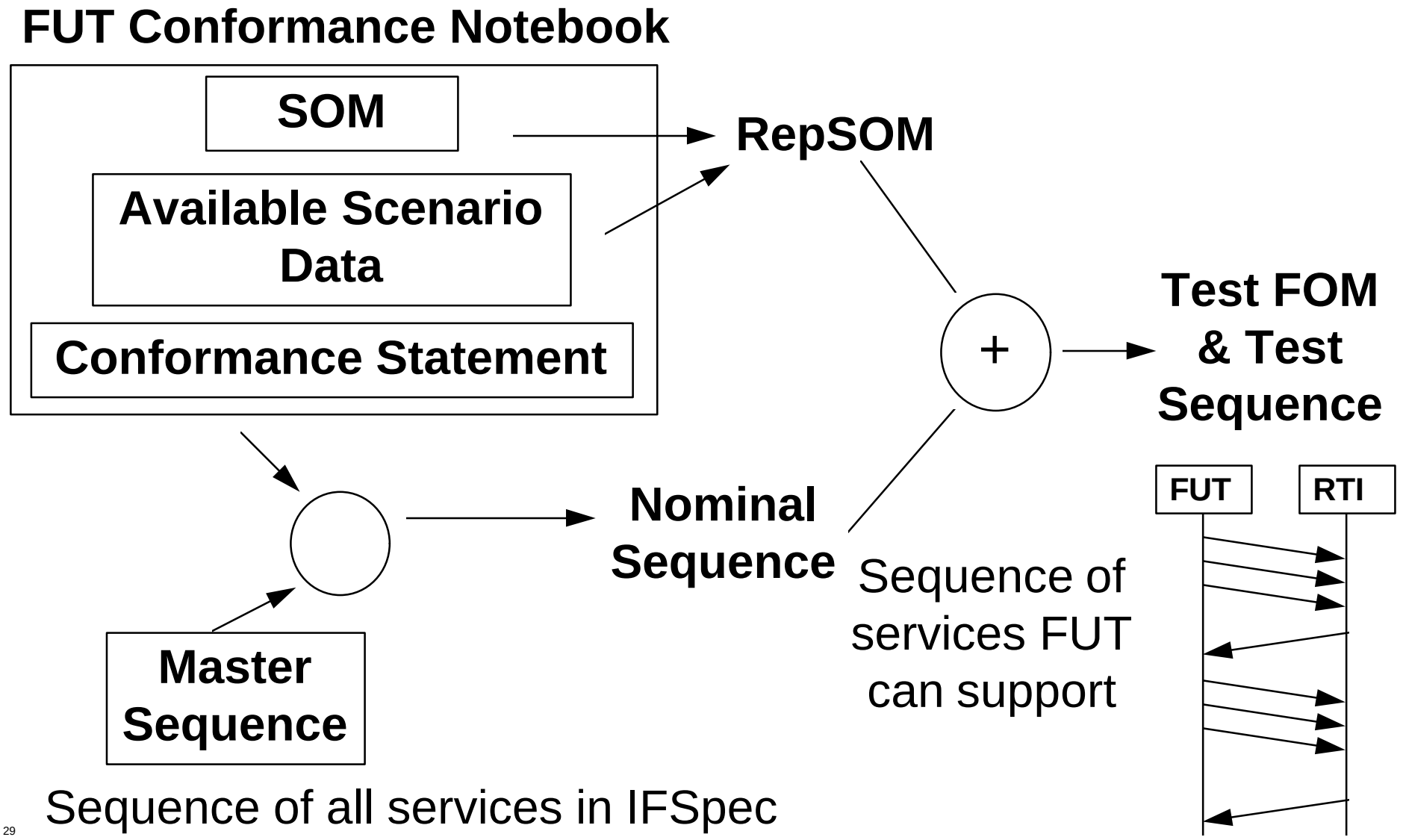
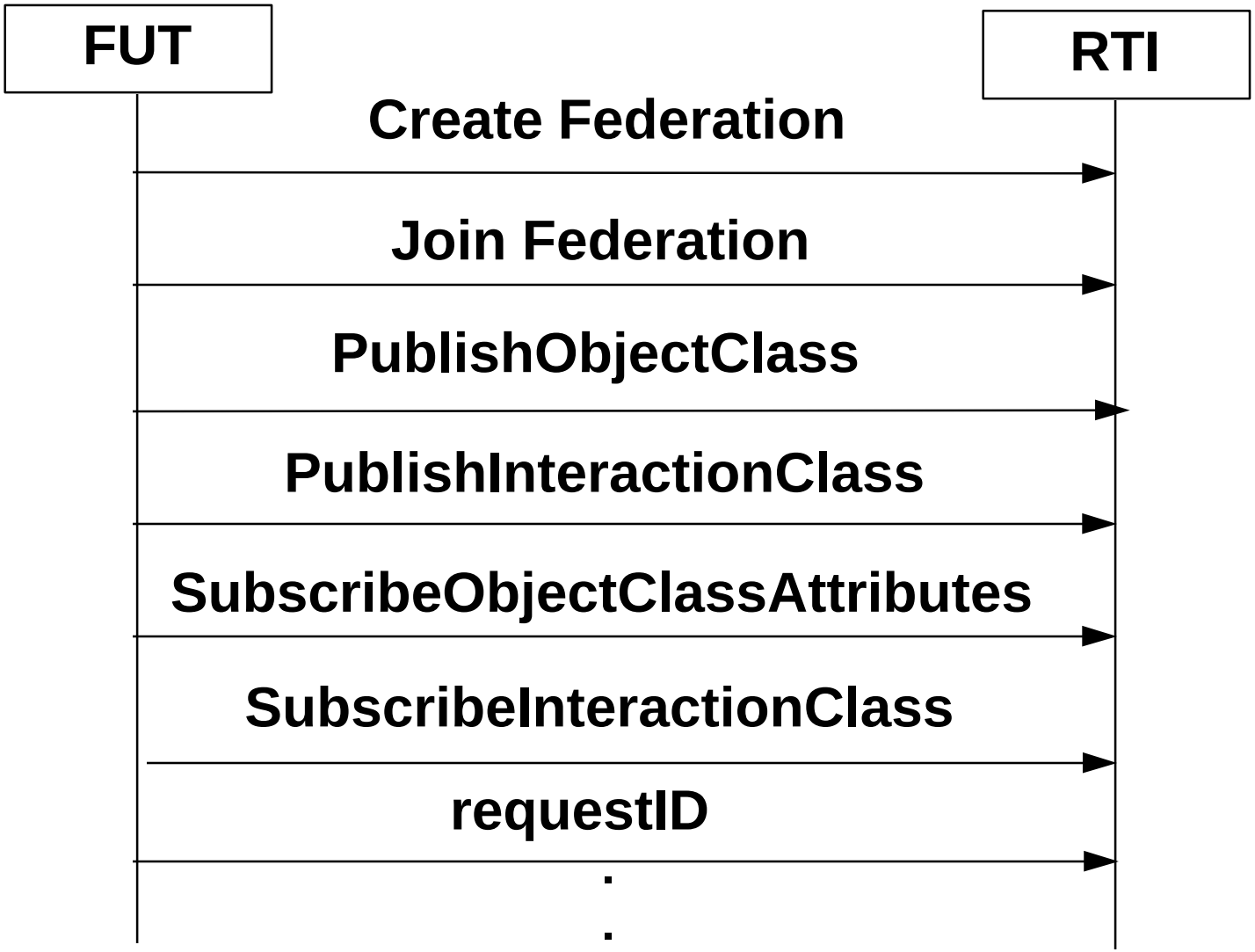
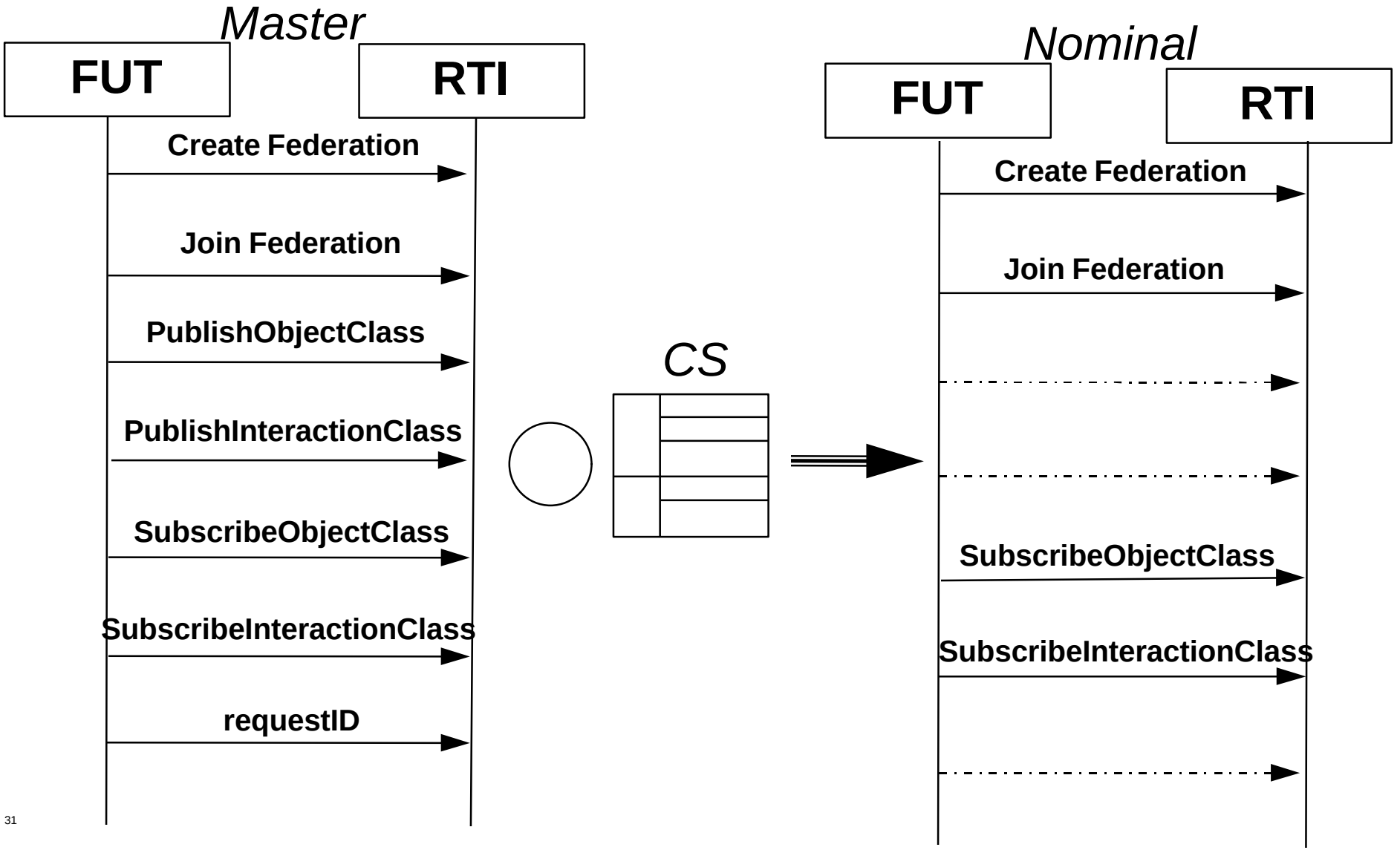
Certification Agent Generates Interface Test Sequence



Master Sequence



Nominal Sequence Generation



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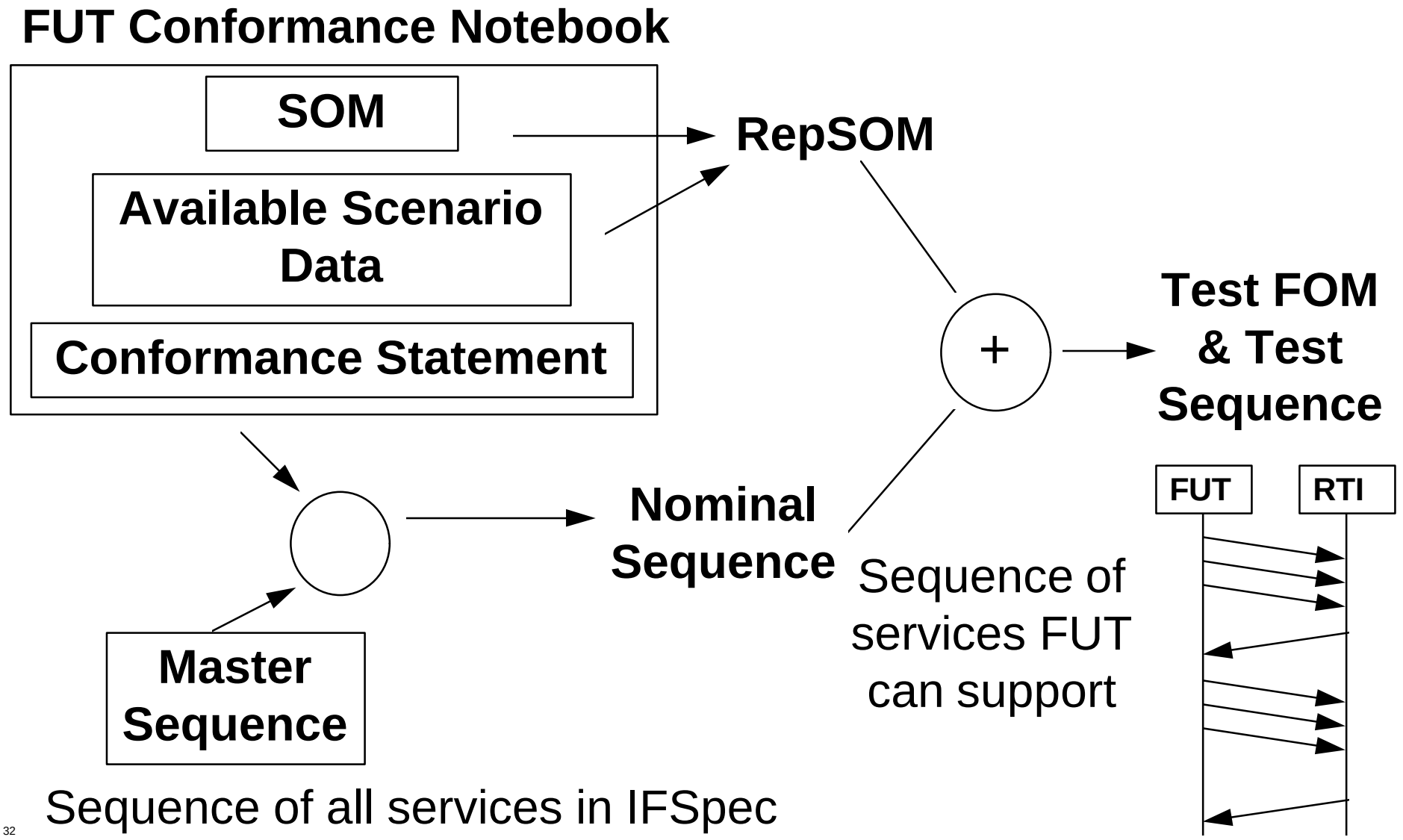


RepSOM Generation

RepSOM rules select a logical subset of the SOM for testing (Test FOM)

The rules are based on the following logic:

X = no. of Objects (attributes or interactions)

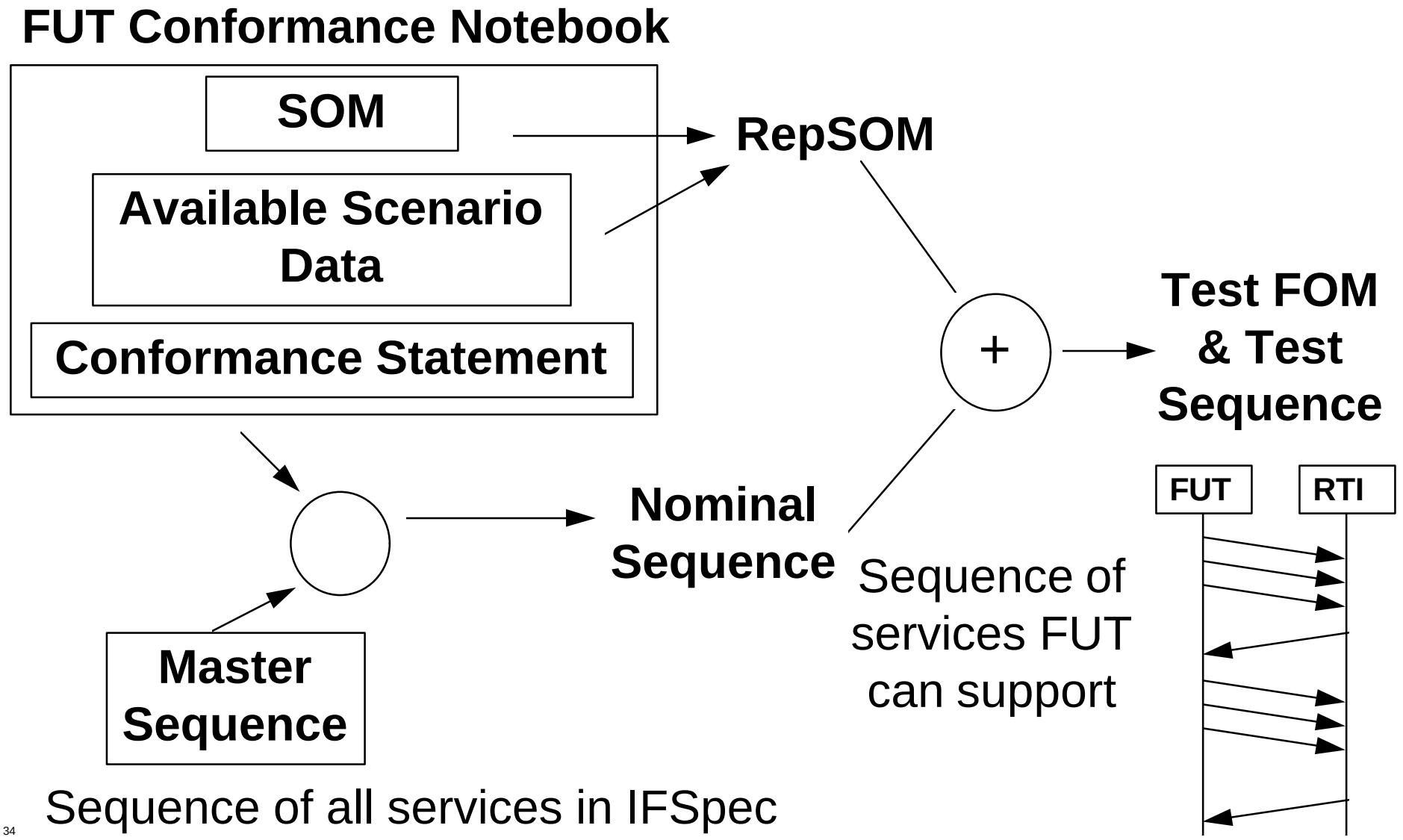
If X <= 3

demonstrate (FUT can do) X

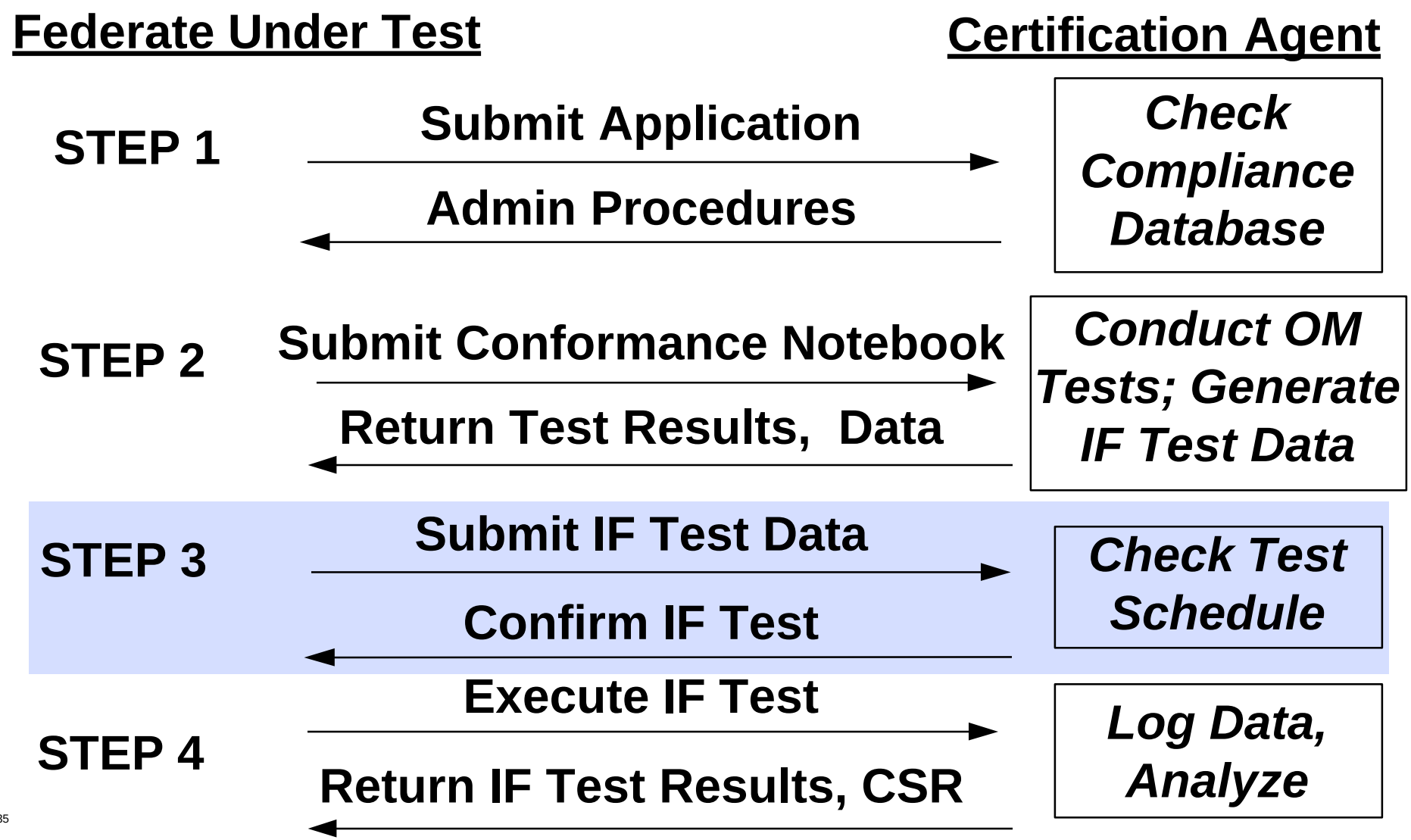
else if X > 3

demonstrate (FUT can do) 3

Certification Agent Generates Interface Test Sequence



The Test Process



Step 3: IF Test Set-up

- **Once the Test Sequence is returned, the FUT submits the following information to the Certification Agent:**
  - **Federation Execution Planning Workbook**
  - .rid and .fed files
  - Requirements for Auxiliary Federates
  - Ability to subset FOM across instances of itself
- In addition to submitting the above information, the FUT confirms the Test Sequence and Test Date with the Certification Agent
- The Certification Agent confirms the scheduled Test Date and prepares for the test

Federation Execution Planning Workbook

Data from the Federation Execution Planning Workbook is used to assist the Certification Agent in conducting and documenting the IF test

Condition	Value
RTI fedex host	Host machine for FedEx
API used	C++, IDL, Ada
Federate hardware	Sun, SGI, HP, IBM
Federate OS	Solaris, Irix, AIX

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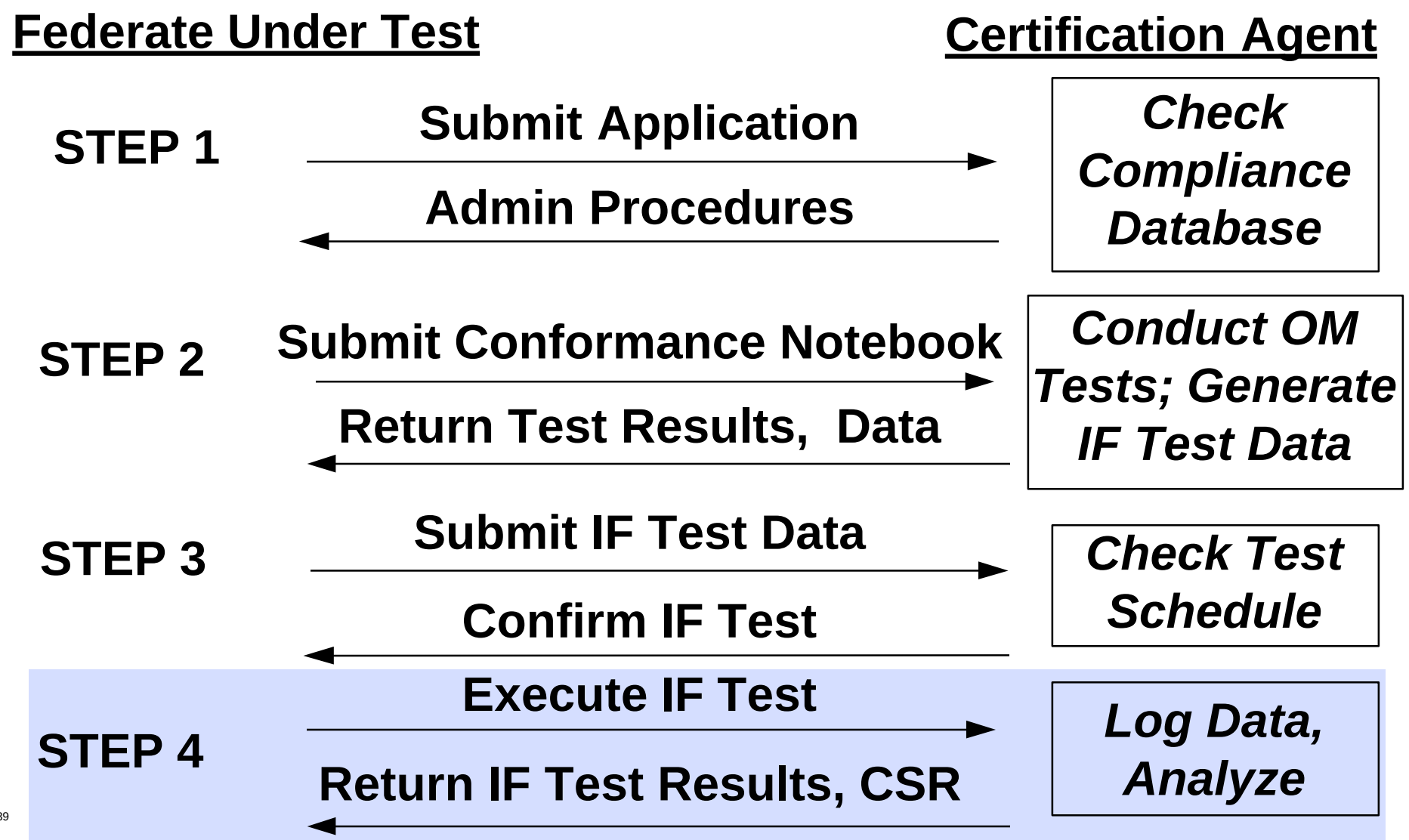


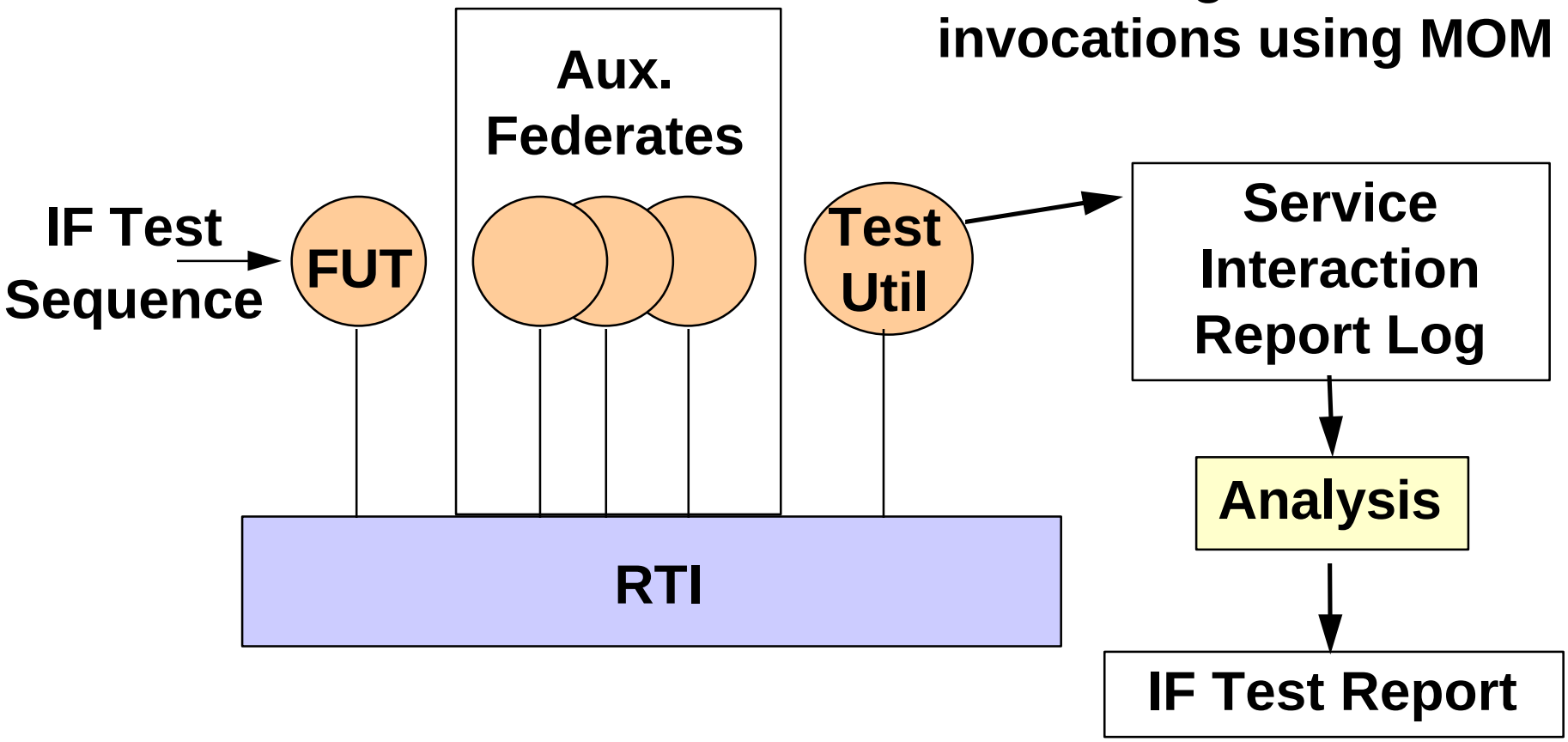
Step 4: IF Test

- **On the scheduled test date, the Certification Agent and the FUT establish a network connection**
- **After the FUT creates the Federation, the Test Utility joins the Test Federation and logs service invocations via the MOM**
- **Once the FUT completes the test sequence, the Certification Agent analyzes the service interaction report log**
- **When the FUT has successfully completed the IF test, a Certification Summary Report is generated and returned to the FUT**

IF Test Execution

FUT executes test sequence using scenario and auxiliary federates, as required

Test Utility joins federation and logs service invocations using MOM



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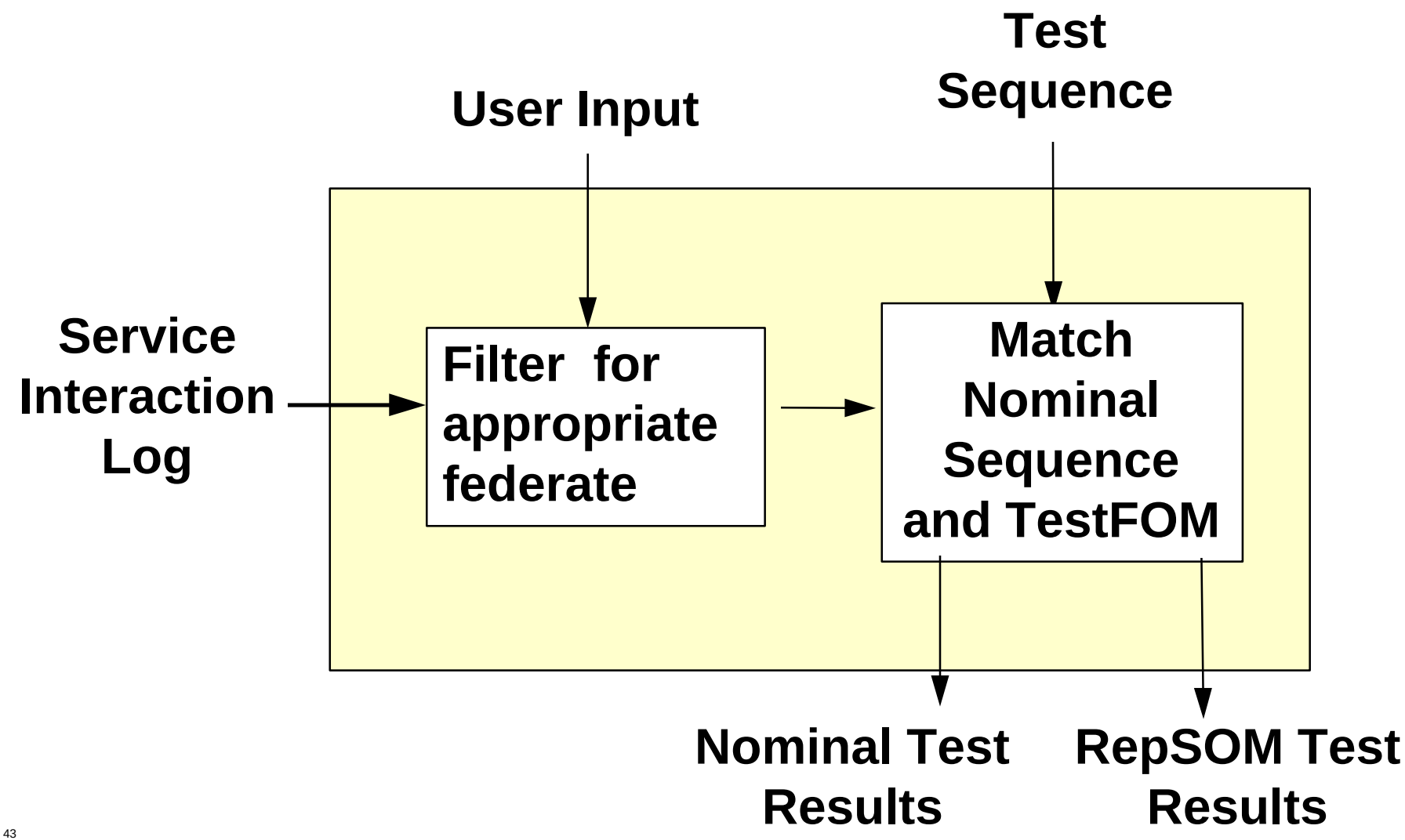
Analyzing Test Data



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Certification Summary Report

- FUT Information
  - Name, version number, test poc
- Test Configuration
  - Federation Execution Planning Workbook
- Test Results
  - SOM
  - Conformance Cross-Check
  - IF Specification
- Supporting Information
  - Conformance Notebook
    - SOM, CS, Scenario Data
  - RepSOM
  - Test Sequence

Federate Compliance Test Process Status (9/97)

- Process developed with initial versions of automated test tools
- Process in evaluation now with “friendly victims”
  - Test process completed for:
    - Jager
    - FMC (Federate Manager-Controller)
  - SOM Conformance Test and Conformance Cross Check Test completed for:
    - NASM/AP (National Air and Space [Warfare] Model / Advanced Prototype)
    - CCTT (Close Combat Tactical Trainer)

Status (9/97) - Continued

- Other “friendly victims” to be tested this month:
  - Eagle
  - NSS
  - ModSAF
  - Hello World
- Federate Compliance Test available to DoD community 1st Qtr FY 98

Panel Discussion

- "Friendly victims" - FMC, CCTT, NASM/AP
- Test developers - GTRI
- Certification Agent - AB Technologies
- DMSO Representative